

CLAIMS

WHAT IS CLAIMED IS:

- 1 1. A method of fabricating a semiconductor device
2 comprising the steps of:
3 / a) forming a non selective N type buried layer
4 comprising a first majority dopant having a
5 first coefficient of diffusion; and
6 b) forming a selective P type buried layer
7 comprising a second majority dopant having a
8 coefficient of diffusion greater than said
9 first coefficient of diffusion.

- 1 2. The method set forth in claim 1 wherein the step
2 of forming said non selective N type buried layer
3 / is performed before the step of forming said
4 selective P type buried layer.

- 1 3. The method set forth in claim 1 wherein the step
2 of forming said selective P type buried layer is
3 3c performed before the step of forming said non
4 selective N type buried layer.

- 1 4. The method set forth in claim 1 wherein the step
2 of forming said selective P type buried layer
3 includes the step of controlling the amount of
4 said second majority dopant relative to the amount
5 \ of said first majority dopant such that said
6 selective P type buried layer over compensates
7 said non selective N type buried layer completely
8 throughout said non selective N type buried layer

9 in a region where said selective P type buried
10 layer is formed.

1 5. The method set forth in claim 1 wherein the step
2 of forming said selective P type buried layer
3 includes the step of controlling the amount of
4 said second majority dopant relative to the amount
5 of said first majority dopant such that said
6 selective P type buried layer does not completely
7 over compensate said N type buried layer
8 throughout said non selective N type buried layer
9 in a region where said selective P type buried
10 layer is formed.

1 6. The method set forth in claim 1 wherein the step
2 of forming said non selective N type buried layer
3 includes the step of selecting said first majority
4 dopant from one of arsenic or antimony and the
5 step of forming said selective P type buried layer
6 includes the step of selecting boron for said
7 second majority dopant.

1 7. The method set forth in claim 1 wherein the step
2 of forming said selective P type buried layer
3 includes the step of controlling the amount of
4 said second majority dopant relative to the amount
5 of said first majority dopant such that said
6 selective P type buried layer has a maximum dopant
7 concentration greater than the maximum dopant
8 concentration of said non selective N type buried
9 layer.

1 8. The method set forth in claim 1 further including
2 the steps of:
3 a) forming an N type layer on said non
4 selective N type buried layer; and
5 b) forming a P well extending from said
6 \ selective P type buried layer through said N
7 type layer.

1 9CB 9. The method set forth in claim 8 in which ~~the~~
2 2/22/02 dopants from the N type and P type buried layers
3 | diffuse into the N type layer.

1 10. The method set forth in claim 9 in which the
2 dopants of the P type buried layer extend further
3 into the N type layer than do the dopants of the N
4 type buried layer.

1 11. The method set forth in claim 8 wherein the step
2 of forming said P well includes the step of
3 controlling the amount of a majority dopant used
4 in forming said P well relative to the amount of
5 | said first majority dopant such that the maximum
6 majority dopant concentration of said non
7 selective N type buried layer is greater than the
8 maximum majority dopant concentration of said P
9 well.

1 12. The method set forth in claim 1 wherein the step
2 of forming said selective P type buried layer

3 includes the steps of implanting and diffusing
4 said second majority dopant.

1 13. The method set forth in claim 12 further including
2 the additional step of forming an epitaxial layer
3 on said selective P type buried layer after the
4 step of implanting said second majority dopant.

1 14. The method set forth in claim 13 wherein the step
2 of forming said epitaxial layer is performed
3 before the step of diffusing said second majority
4 dopant.

1 15. The method set forth in claim 14 wherein the step
2 of diffusing said first majority dopant includes
3 the step of controlling said diffusion such that
4 said second majority dopant up diffuses into said
5 epitaxial layer.

1 16. The method set forth in claim 12 further including
2 the steps of:
3 a) forming an N type layer on said non
4 selective N type buried layer; and
5 b) forming a P well extending from said
6 selective P type buried layer through said N
7 type layer.

1 17. The method set forth in claim 16 wherein the step
2 of forming said N type layer is performed before
3 the step of diffusing said second majority dopant.

1 18. The method set forth in claim 17 wherein the step
2 of forming said P well includes the step of
3 controlling the amount of a majority dopant used
4 in forming said P well relative to the amount of
5 said first majority dopant such that the maximum
6 majority dopant concentration of said non
7 selective N type buried layer is greater than the
8 maximum majority dopant concentration of said P
9 well.

1 19. The method set forth in claim 1 wherein
2 a) the step of forming said non selective N
3 type buried layer includes the steps of
4 implanting and diffusing said first majority
5 dopant; and
6 b) the step of forming said selective P type
7 buried layer includes the steps of
8 implanting and diffusing said second
9 majority dopant.

1 20. The method set forth in claim 19 wherein the steps
2 of implanting and diffusing said first majority
3 dopant are performed before the steps of
4 implanting and diffusing said second majority
5 dopant.

1 21. The method set forth in claim 19 further including
2 the additional step of forming an epitaxial layer
3 on said selective P type buried layer after the
4 step of implanting said second majority dopant.

- 1 22. The method set forth in claim 21 wherein the step
2 of forming said epitaxial layer is performed
3 before the step of diffusing said second majority
4 dopant.
- 1 23. The method set forth in claim 22 wherein the step
2 of diffusing said first majority dopant includes
3 the step of controlling said diffusion such that
4 said first majority dopant up diffuses into said
5 epitaxial layer.
- 1 24. The method set forth in claim 21 wherein the step
2 of forming said epitaxial layer is performed
3 before the step of diffusing said first majority
4 dopant.
- 1 25. The method set forth in claim 24 wherein the step
2 of diffusing said first majority dopant includes
3 the step of controlling said diffusion such that
4 said first majority dopant up diffuses into said
5 epitaxial layer.
- 1 26. A method of fabricating a semiconductor device in
2 a wafer comprising the steps of:
3 a) implanting across all of said wafer an N
4 type dopant having a first coefficient of
5 diffusion and at a first dose level;
6 b) diffusing said N type dopant into said wafer
7 to form an N type buried layer;
8 c) masking a portion of said wafer;

9 d) implanting into said wafer in areas not
10 masked a P type dopant having a coefficient
11 of diffusion greater than said first
12 coefficient of diffusion; and
13 e) diffusing said p type dopants into said
14 wafer to form a P type buried layer.

1 27. The method set forth in claim 26 wherein the step
2 of implanting said N type dopant is performed
3 before the step of implanting said P type dopant.

1 28. The method set forth in claim 26 wherein the step
2 of implanting said P type dopant is performed
3 before the step of implanting said N type dopant.

1 29. The method set forth in claim 26 wherein the step
2 of implanting said P type dopant includes the step
3 of controlling the amount of said P type dopant
4 relative to the amount of said N type dopant such
5 that said P type buried layer has a maximum dopant
6 concentration greater than the maximum dopant
7 concentration of said N type buried layer.

1 30. The method set forth in claim 26 further including
2 the steps of:
3 a) forming an N type layer on said N type
4 buried layer; and
5 b) forming a P well extending from said P type
6 buried layer through said N type layer.

- 1 31. The method set forth in claim 30 wherein the step
2 of forming said N type layer is performed before
3 the step of diffusing said P type dopant.
- 1 32. The method set forth in claim 31 wherein the step
2 of forming said P well includes the step of
3 controlling the amount of a majority dopant used
4 in forming said P well relative to the amount of
5 said N type dopant such that the maximum majority
6 dopant concentration of said N type buried layer
7 is greater than the maximum majority dopant
8 concentration of said P well.
- 1 33. The method set forth in claim 26 wherein the steps
2 of implanting and diffusing said N type dopant are
3 performed before the steps of implanting and
4 diffusing said P type dopant.
- 1 34. The method set forth in claim 26 further including
2 the additional step of forming an epitaxial layer
3 on said P type buried layer after the step of
4 implanting said P type dopant.
- 1 35. The method set forth in claim 34 wherein the step
2 of forming said epitaxial layer is performed
3 before the step of diffusing said P type dopant.
- 1 36. The method set forth in claim 35 wherein the step
2 of diffusing said N type dopant includes the step
3 of controlling said diffusion such that said N
4 type dopant up diffuses into said epitaxial layer.

1 37. The method set forth in claim 34 wherein the step
2 of forming said epitaxial layer is performed
3 before the step of diffusing said N type dopant.

1 38. The method set forth in claim 37 wherein the step
2 of diffusing said N type dopant includes the step
3 of controlling said diffusion such that said N
4 type dopant up diffuses into said epitaxial layer.

1 39. The method set forth in claim 26 wherein the step
2 of implanting said N type dopant includes the step
3 of selecting said N type dopant from one of
4 arsenic or antimony and the step of implanting
5 said P type dopant includes the step of selecting
6 boron for said P type dopant.

1 40. A method of fabricating a semiconductor device in
2 a wafer comprising the steps of:

3 a) growing an epitaxial layer doped with an n
4 type dopant having a first coefficient of
5 diffusion and a first doping level to form
6 an N type buried layer;

7 b) masking a portion of said wafer;

8 c) implanting into said wafer in areas not
9 masked a P type dopant having a coefficient
10 of diffusion greater than said first
11 coefficient of diffusion; and

12 d) diffusing said p type dopants into said
13 wafer to form a P type buried layer.

1 41. The method set forth in claim 40 wherein the step
2 of implanting said P type dopant includes the step
3 of controlling the amount of said P type dopant
4 relative to the amount of said first doping level
5 such that said P type buried layer over
6 compensates said N type buried layer completely
7 throughout said N type buried layer in a region
8 where said P type buried layer is formed.

1 42. The method set forth in claim 40 wherein the step
2 of implanting said P type dopant includes the step
3 of controlling the amount of said P type dopant
4 relative to the amount of said first doping level
5 such that said P type buried layer has a maximum
6 dopant concentration greater than the maximum
7 dopant concentration of said N type buried layer.

1 43. The method set forth in claim 40 further including
2 the steps of:
3 a) forming an N type layer on said N type
4 buried layer; and
5 b) forming a P well extending from said P type
6 buried layer through said N type layer.

1 44. The method set forth in claim 43 wherein the step
2 of forming said P well includes the step of
3 controlling the amount of a majority dopant used
4 in forming said P well relative to the amount of
5 said first doping level such that the maximum
6 majority dopant concentration of said N type

buried layer is greater than the maximum majority dopant concentration of said P well.

45. The method set forth in claim 40 further including the step of forming a second epitaxial layer on said N type buried layer.

46. The method set forth in claim 45 wherein the step of forming said second epitaxial layer is performed before the step of diffusing said P type dopants.

47. The method set forth in claim 40 wherein the step of growing an epitaxial layer includes the step of selecting said N type dopant from one of arsenic or antimony and the step of implanting includes the step of selecting boron for said P type dopant.

48. A method of fabricating a semiconductor device in a wafer comprising the steps of:

- a) bonding a device wafer doped N type to a first doping level with a dopant having a first coefficient of diffusion to a handle wafer by insulator bonding and separating a desired thickness of said device wafer to form an SOI layer which is also an N type buried layer;
- b) introducing P type dopants having a second coefficient of diffusion greater than said first coefficient of diffusion in a selected

13 region of said SOI layer to form a P type
14 buried layer;
15 c) forming an epitaxial layer on the surface of
16 said SOI layer; and
17 d) diffusing so that the P type dopants extend
18 up into said epitaxial layer further than
19 the N type dopants in said SOI layer.

1 49. The method set forth in claim 48 wherein the step
2 of introducing said P type dopants includes the
3 step of controlling the amount of said P type
4 dopants relative to the amount of said first
5 doping level such that said P type buried layer
6 over compensates said N type buried layer
7 completely throughout said N type buried layer in
8 a region where said P type buried layer is formed.

1 50. The method set forth in claim 48 wherein the step
2 of introducing said P type dopants includes the
3 step of controlling the amount of said P type
4 dopants relative to the amount of said first
5 doping level such that said P type buried layer
6 has a maximum dopant concentration greater than
7 the maximum dopant concentration of said N type
8 buried layer.

1 51. The method set forth in claim 48 further including
2 the steps of forming a P well extending from said
3 P type buried layer through said epitaxial layer.

1 52. The method set forth in claim 51 wherein the step
2 of forming said P well includes the step of
3 controlling the amount of a majority dopant used
4 in forming said P well relative to the amount of
5 said first doping level such that the maximum
6 majority dopant concentration of said N type
7 buried layer is greater than the maximum majority
8 dopant concentration of said P well.

1 53. The method set forth in claim 48 wherein the step
2 of bonding includes the step of selecting the N
3 type dopant from one of arsenic or antimony and
4 the step of introducing P type dopants includes
5 the step of selecting boron for said P type
6 dopants.

1 54. A method for forming an N+ buried layer comprising
2 the steps of:
3 a) oxidizing the top and bottom surfaces of an
4 N+ device wafer;
5 b) bonding a handle wafer to said bottom oxide
6 layer; and
7 c) removing said top oxide layer.

1 55. The method set forth in claim 54 further including
2 the step of thinning said N+ device wafer.

1 56. A method for forming an N+ buried layer comprising
2 the steps of:

- 3 a) providing a device wafer bonded to an oxide
- 4 layer which, in turn, is bonded to a handle
- 5 wafer;
- 6 b) implanting N type dopants into said device
- 7 wafer across the entire top surface of said
- 8 device wafer; and
- 9 c) diffusing said N type dopants into said
- 10 device wafer.